Welcome to the Next Generation Internet (NGI) Initiative's Netamorphosis

Creating the next generation of high-capability, high-speed Internet technologies

The NGI Initiative is a multi-agency Federal program that conducts R&D in:

- Advanced networking technologies to enable an Internet that is:
  - Fast
  - Reliable
  - Secure
  - Affordable
  - Ubiquitous
  - Intelligent
- Revolutionary applications that advance U.S. interests and benefit the American public in areas including:
  - National security and defense
  - Economic competitiveness
  - Industrial productivity
  - Education
  - Health care
  - The environment

These networking technologies will be scalable to the commercial Internet, and the applications will be extensible to commercial use in U.S. businesses, schools, and homes.

Next Generation INTERNET (NGI) Goals

Conduct R&D in advanced end-to-end networking technologies to improve performance in:

- Reliability
- Security
- Quality of service/differentiated service (including multicast and audio/video)
- Network management (including allocation and sharing of bandwidth)

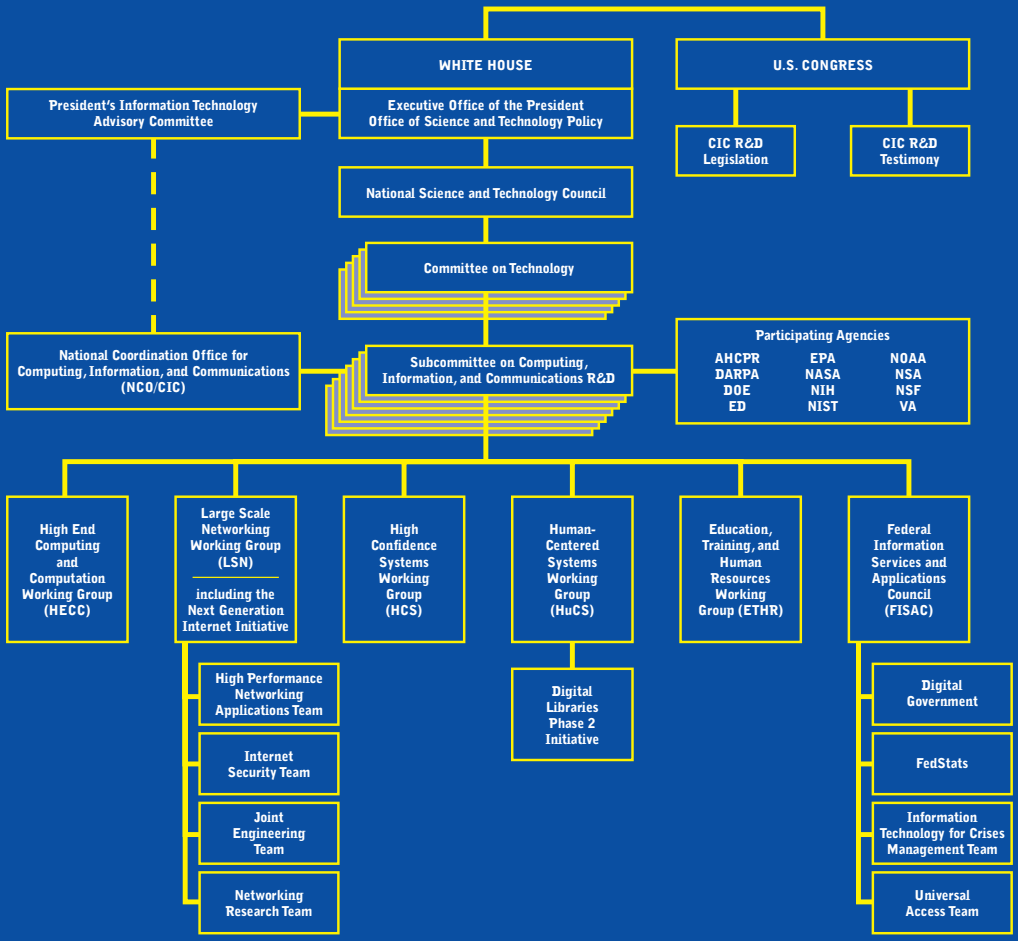
Develop NGI testbeds to:

- Connect at least 100 NGI sites with end-to-end performance at least 100 times faster than today's Internet
  - Built on NSF's vBNS, NASA's NREN, and DoD's DREN in partnership with Internet2 universities.
- Connect about 10 sites with end-to-end performance at least 1,000 times faster than today's Internet
  - Built on DARPA's SuperNet
- Conduct system-scale testing of advanced networking technologies and services
- Develop and test advanced applications

Develop and demonstrate revolutionary applications in:

- Enabling applications technologies, such as:
  - Collaboration technologies
  - Digital libraries
  - Distributed computing
  - Privacy and security
  - Remote operation and simulation
- Disciplinary applications:
  - Basic science
  - Crisis management
  - Education
  - The environment
  - Federal information services
  - Health care
  - Manufacturing

How the Next Generation Internet (NGI) Initiative is Coordinated

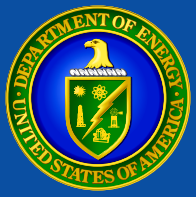


Large Scale Networking (LSN) Working Group

The NGI Initiative is coordinated by the Large Scale Networking (LSN) Working Group of the National Science and Technology Council's Subcommittee on Computing, Information, and Communications (CIC) R&D.

NGI agencies:

Other LSN agencies:



How You Can Get Involved in the NGI Initiative

Industry

- Participate in NGI testbeds coordinated by the Federal ***Joint Engineering Team***
- Participate in NGI workshops

Researchers

- Participate in research coordinated by the Federal ***Networking Research Team***
- Contact a Federal ***High Performance Networking Applications Team*** agency representative if you are developing an application that would benefit from advanced NGI technologies
- Participate in NGI workshops
- Apply for meritorious applications use of NGI networks (NSF for vBNS applications, NASA for NREN applications)

Federal Agencies

- Participate in activities of the LSN and its Teams:
  - ***Joint Engineering Team***
  - ***High Performance Networking Applications Team***
  - ***Internet Security Team***
  - ***Networking Research Team***
- as well as activities of the CIC's:
  - ***Federal Information Services and Applications Council***

Media

- Contact the ***National Coordination Office for Computing, Information, and Communications*** (NCO/CIC) Phone: 703/306-4722
- Contact an ***LSN agency representative*** to learn more about NGI activities and accomplishments.
- Visit the NCO web site at http://www.ccic.gov/ and the NGI web site at http://www.ngi.gov/.

Remote Access Multidimensional Microscopy (RAMM):

Viewing the Changing Threads of Life with 4D Telemicroscopy

DESCRIPTION

This online microscope system non-invasively digitizes 3D images of living organisms as their cellular and subcellular structures evolve, such as a worm embryo undergoing division or a fruitfly's wings taking form. 4D data sets (3D space plus time) can be acquired, viewed, and analyzed remotely.

SPONSORS

National Institutes of Health (NIH): National Center for Research Resources

PERFORMERS

- Digital Microscopy Group – Integrated Microscopy Resource (IMR)
- University of Wisconsin-Madison

USERS & USES

The RAMM Initiative allows medical research groups, scientists, and educators to access, remotely and collaboratively, the IMR's 4D microscopy system for observation and experimentation, without having to invest in technology or equipment.

MILESTONES

- Build the BIOLAN biology ATM network at the University of Wisconsin-Madison to link the IMR to its users
- Port the 4D software to Java

NGI CONTRIBUTIONS

Increased bandwidth to transmit 100+ MB data sets and improved real-time imaging essential for remotely manipulating the microscope without affecting an organism's development.

Broadcast News Navigator

DESCRIPTION

A search and retrieval application, Broadcast News Navigator indexes, summarizes and displays recorded broadcast news stories.

SPONSORS

Defense Advanced Research Projects Agency (DARPA)

PERFORMERS

- The MITRE Corporation
- DARPA
- National Security Agency (NSA)

USERS & USES

Government agencies and broadcasters identify and view news stories on issues, people, organizations, and locations of interest.

MILESTONES & ACCOMPLISHMENTS

Recent integration of geospatial visualization capabilities, English and foreign language processing systems, and user visualization evaluations.

NGI CONTRIBUTION

Access to user groups with advanced networking capabilities who can evaluate and help improve application performance.

Distributed Image Spreadsheet:

Earth Data from Satellite to Desktop

DESCRIPTION

With the Distributed Image Spreadsheet (DISS), scientists visualize, manipulate, and analyze massive geologic, atmospheric, and oceanographic data sets transmitted to their desktops from Earth Observing System satellites.

SPONSORS

National Aeronautics and Space Administration (NASA):
Goddard Space Flight Center

PARTNERS

- NASA: Goddard Space Flight Center – Ames Research Center
- National Oceanic and Atmospheric Administration (NOAA): Hurricane Research Division
- University of Missouri – Columbia

USERS AND USES

Government agencies, universities, corporations, and weather services use DISS data for atmospheric, oceanographic, biospheric, and land use studies.

NGI CONTRIBUTIONS

NGI advancements toward OC-12 and higher bandwidths will enhance distributed file systems, input/output performance of multimedia digital libraries, and memory and graphics visualization.

Exploring the Earth System on the "Second Web"

DESCRIPTION

3D virtual worlds on the Web teleport viewers into high-resolution, stereo/3D animations of tropical storms, forest fires, clear air turbulence, cyclones, and El Nino.

SPONSORS

- National Science Foundation (NSF)
- U.S. Forest Service
- Department of Energy (DoE)
- Silicon Graphics, Inc.

PERFORMERS

National Center for Atmospheric Research (NCAR)

USERS & USES

Researchers and educators create and share Earth system data to study patterns and behaviors behind naturally-occuring, and sometimes dangerous, phenomena. New Web technologies make it possible to share detailed, intricate Earth system observations and simulations in stereo/3D with other researchers, educators, and the public.

NGI CONTRIBUTION

High-bandwidth, wide-area networks coupled with 3D Web technologies and realtime data compression allow multiple remote users to share and explore science in virtual 3D worlds.

Real-Time Functional MRI (fMRI):

Watching the Brain in Action

DESCRIPTION

The Brain in Action allows remote viewing of brain activity while a patient is executing cognitive or sensory-motor tasks.

PERFORMERS

- Pittsburgh Supercomputing Center
- Carnegie Mellon University
- University of Pittsburgh

SPONSORS

- National Institutes of Health (NIH): National Center for Research Resources
  National Institute on Drug Abuse
  National Institute of Mental Health
- National Science Foundation (NSF)

USERS & USES

Neurosurgeons, neurologists, psychiatrists, and brain scientists will investigate brain function and diagnose and treat brain diseases. For example, this application will enable neurosurgeons to develop surgical plans for tumor removal through understanding the cognitive and sensory-motor abilities located near a tumor site.

MILESTONES & ACCOMPLISHMENTS

Demonstrations of real-time processing of fMRI data, where acquisition, processing, and visualization occur at physically distinct sites linked by NSF's vBNS and other advanced networks. Latency from scanner acquisition to display is less than 10 seconds.

NGI CONTRIBUTIONS

NGI advances will improve capacity, interactive real-time capability, security, patient confidentiality guarantees, and reliable data delivery between the fMRI acquisition site, the processing site, and the visualization site.

Hurricane Forecasting

DESCRIPTION

The Geophysical Fluids Dynamics Laboratory (GFDL) Hurricane Prediction System is a comprehensive computer forecast system that predicts the behavior, up to three days in advance, of hurricanes such as Georges and Bonnie. Predictions include not only storm motion, but also intensity, precipitation, and 3D fields, such as wind, temperature, and humidity. The system incorporates information about atmospheric conditions ranging from large scale to hurricane scale.

SPONSORS

National Oceanic and Atmospheric Administration (NOAA)

PERFORMERS

- NOAA: Geophysical Fluids Dynamics Laboratory (GFDL)
  National Centers for Environmental Prediction (NCEP)
  National Hurricane Center (NHC)
- Department of Defense (DoD): U.S. Navy Fleet Numerical Meteorology and Oceanography Center
- University of Rhode Island

USERS & USES

In 1995, the NCEP adopted the GFDL Hurricane Prediction System for operational hurricane prediction at the National Weather Service. Since then, the GFDL model has, on average, predicted storm tracks more accurately than any other model and has helped save national resources, including both lives and millions of dollars in evacuation costs.

NGI CONTRIBUTIONS

NGI will lead to improved collection of observational data and more effective dissemination of storm warnings to the public.

Interactive Video Dialogues

DESCRIPTION

Voice-controlled multimedia scenarios engage users and virtual characters in face-to-face, realistic, dramatic dialogue for education and training, using the Conversim™ interface software developed by Interactive Drama Inc.

SPONSORS

- Defense Advanced Research Projects Agency (DARPA)
- National Institutes of Health (NIH)

PERFORMERS

Defense Language Institute

USERS & USES

Interactive Video Dialogues applications range from combat casualty triage training to knowledge systems to language training. For example, military linguists located anywhere in the world can sustain language proficiency by routinely talking in virtual dialogue with native speakers.

NGI CONTRIBUTIONS

Enhanced network capacity to accommodate large quantities of full-motion, broadcast-quality video in a speech recognition environment.

Collaborative, Remote Robotic Arc Welding

DESCRIPTION

Collaborative robotic arc welding brings engineers and equipment at a welding cell site together with weld engineers at a remote laboratory to collaborate on R&D to improve industrial welding practices. Network technologies enable video connectivity between the two sites, along with remote monitoring, sharing, and analysis of weld quality information.

SPONSORS & PERFORMERS

National Institute of Standards and Technology (NIST)

- Part of the National Advanced Manufacturing Testbed Program and jointly conducted by NIST's
  - Manufacturing Engineering Laboratory (MEL)
  - Materials Science and Engineering Laboratory (MSEL)

USERS & USES:

Develop and demonstrate methods for improving practices of the American welding community, which includes the automobile, heavy equipment, and shipbuilding industrial sectors. Focus areas include:

- Better communication between production planning and control and shop floors
- Better weld cell programming tools
- Better sensors and techniques for monitoring welding processes
- Easy data transfer and remote access to control processes
- Remote and seamless access to control processes and weld quality data
- Improved performance of real-time process controllers

NGI CONTRIBUTION

High-performance networking with high speeds, low latencies, guaranteed quality of service, and secure connections to enable full-motion video between sites and remote instrument/cell control.

GeoWorlds: *Integrated Digital Libraries and Geographic Information Systems for Disaster Relief Operations*

DESCRIPTION

Synergizing two technologies — digital libraries and geographic information technologies — GeoWorlds retrieves, organizes, and displays everything known about a region in rich displays, allowing teams of users in disparate locations to collaboratively assess disaster situations and develop appropriate responses.

SPONSOR

Defense Advanced Research Projects Agency (DARPA)

PERFORMERS

- University of Southern California: Information Sciences Institute
  Department of Geography
- University of California Santa Barbara: Alexandria Digital Library Project
- University of Illinois at Urbana-Champaign: Digital Library Initiative
- University of Arizona: Artificial Intelligence Laboratory
- University of California at Berkeley: Digital Library Project
- University of Illinois: National Center for Supercomputing Applications

USERS & USES

GeoWorlds supports humanitarian assistance and disaster relief, helping response teams assess the impact of disasters, identify assets and partners that can contribute to a response, and evaluate geographic constraints on response plans. GeoWorlds can also be applied to business planning, local government land use, law enforcement, and intelligence analysis.

MILESTONES & ACCOMPLISHMENTS

GeoWorlds' development plan calls for eight software releases in less than a year, each with incremental additions in functionality. The integration architecture is defined, and the fourth software release is complete. The Crisis Operations Center of the U.S. Pacific Command (USPACOM) will begin experimental use in late 1998.

NGI CONTRIBUTIONS

For maximum effectiveness, GeoWorlds needs extremely high bandwidth and controlled Quality of Service to move massive amounts of map, image, and document information. NGI technologies will improve access to real-time geographic information system data from remote sources and support multiple collaborative disaster relief sessions.

Testing and Measuring Internet Protocol (IP) Quality of Service (QoS)

DESCRIPTION

- ***NIST Net*** emulates arbitrary performance characteristics of complex IP networks, enabling controlled and reproducible QoS sensitivity experiments for application/protocol R&D.
- ***NIST Switch*** is an experimental, prototype platform for research in Multi Protocol Label Switching (MPLS), QoS routing, and QoS signaling protocol mechanisms.
- ***DIPPER***, a ***D***istributed ***I***nternet ***P***rotocol and ***PER***formance test system, allows a researcher to test IP QoS signaling and forwarding mechanisms between multiple remote locations.

SPONSORS & PERFORMERS

National Institute of Standards and Technology (NIST):

- Information Technology Laboratory (ITL)
- Advanced Networking Technology Division (ANTD)

USERS & USES

More than 300 Internet researchers and product developers use NIST's IP QoS testing tools and prototypes when developing QoS-sensitive products.

ACCOMPLISHMENTS & MILESTONES

- March 1998 - NIST Net QoS tool released.
- October 1998 - NIST Switch and DIPPER prototypes released.

NGI CONTRIBUTIONS

NGI will support research on:

- Scalable architectures and mechanisms to support QoS routing, signaling, and management.
- Advanced test, measurement, and analysis tools for new NGI protocol capabilities and networks.

Testing and Measuring Internet Security Technology

DESCRIPTION

- ***NIST Cerberus/Pluto++*** is a prototype reference implementation of IP security and Internet Key Exchange protocols.
- ***IPSec WIT***, a ***W***eb-based ***I***nteroperability ***T***est System, lets researchers and developers conduct interoperability tests of security protocols anytime and anywhere without relocating systems or software.

SPONSORS & PERFORMERS

National Institute of Standards and Technology (NIST)

- Information Technology Laboratory (ITL)
  - Advanced Networking Technology Division (ANTD)
  - Computer Security Division (CSD)

National Security Agency (NSA)

USERS & USES

More than 200 researchers and product developers use NIST tools for R&D on new security protocols and products.

ACCOMPLISHMENTS & MILESTONES

- June 1998 – Initial Cerberus prototype integrated with key management.
- August 1998 – Key management testing added to IPSec WIT online test system.

NGI CONTRIBUTIONS

NGI will support research on:

- Integration of security protocols/key management/certificate systems
- Configuration and management of security policies
- Incorporation of security into QoS architecture and other new NGI network services